<u>WHAT IS CLAIMED IS</u>:

1   1.   A method to create a digital model of a patient's teeth, comprising:

2   creating an impression of the patient's teeth;

3   scanning the impression using an X-ray source; and

4   generating the digital model with scanned data.

1   2.   The method of claim 1, further comprising using passing the radiation

2 source through a scintillator.

1   3.   The method of claim 2, further comprising digitizing the output of the

2 scintillator.

1   4.   The method of claim 1, wherein the impression of the teeth is taken in

2 a plastic tray.

1   5.   The method of claim 1, further comprising taking a bite impression of

2 the patient.

1   6.   The method of claim 5, wherein the bite impression is taken using a

2 PVS material.

1   7.   The method of claim 5, wherein the bite impression is taken using a

2 wax bite.

1   8.   The method of claim 1, wherein an upper teeth impression, a lower

2 teeth impression and a bite impression is scanned together.

1   9.   The method of claim 8, further comprising digitally reversing data

2 from the upper and lower impression scan data to make positive data.

1   10.   The method of claim 9, wherein the digital reversing identifies inner

2 surfaces of an impression material and extracting the inner surfaces using a largest connected

3 component algorithm.

1   11.   The method of claim 1, further comprising aligning data into a bite

2 position using the bite material scanned.

1   12. The method of claim 1, further comprising digitally detailing the teeth

2 data.

1   13. The method of claim 1, further comprising setting a final bite.

1   14. The method of claim 1, further comprising articulating the digital

2 model.

1   15. The method of claim 1, further comprising treating a patient using the

2 digital model.

1   16. The method of claim 1, further comprising:

2   generating a computer representation of a masticatory system of the patient;

3 and

4   determining an occlusion from the computer representation of the masticatory

5 system.

1   17. The method of claim 16, wherein the occlusion is a static occlusion,

2 further comprising:

3   modeling an ideal set of teeth;

4   automatically applying the ideal set of teeth to the computer representation of

5 a masticatory system of the patient; and

6   optimizing the position of the patient's teeth to fit the ideal set of teeth.

1   18. The method of claim 17, wherein the modeling step further comprises

2 selecting one or more arch forms specifying the ideal set of teeth.

1   19. The method of claim 17, wherein the masticatory system includes jaws

2 and wherein the applying step includes:

3   registering a model of the upper and lower teeth with a model of the

4 masticatory system;

5   simulating the motion of the jaws to generate contact data between the upper

6 and lower teeth; and

7   placing a tooth in a final position based on the contact data.

1   20.   The method of claim 19, wherein the model is registered using X-ray

2   data.

1   21.   The method of claim 19, wherein the model is registered using

2   computed tomography data.

1   22.   The method of claim 19, wherein the model is registered using data

2   associated with a mechanical model.

1   23.   The method of claim 19, wherein the simulating step further comprises

2   applying kinematics to the model of the teeth.

1   24.   The method of claim 19, wherein the simulating step further

2   comprises applying a constrained motion to the model of the tooth.

1   25.   The method of claim 19, wherein the placing step is based on a

2   measure of undesirability to the contacts.

1   26.   The method of claim 25, further comprising optimizing the position of

2   the tooth according to the measure of undesirability.

1   27.   The method of claim 26, further comprising minimizing the measure of

2   undesirability.

1   28.   The method of claim 27, wherein the measure of undesirability is a

2   function of one or more of Peer Assessment Rating (PAR) metrics, distance-based metrics

3   and shape-based metrics.

1   29.   The method of claim 17, wherein the simulating step includes

2   providing a library of motions.

1   30.   The method of claim 29, wherein the library of motions includes a

2   protrusive motion.

1   31.   The method of claim 29, wherein the library of motions includes a

2   lateral motion.

1   32.   The method of claim 29, wherein the library of motions includes tooth-
2   guided motions.

1   33.   The method of claim 17, wherein the simulating step includes applying
2   physical forces to one jaw.

1   34.   The method of claim 17, wherein the placing step further includes
2   updating the computer representation of the masticatory system with new patient data.

1   35.   The method of claim 34, wherein the patient has a first teeth model,
2   further comprising:
3   scanning the teeth of the patient to generate a second teeth model;
4   matching the second teeth model with the first teeth model;
5   applying a final position transform to the second teeth model; and
6   adjusting the position of teeth in the second model based on new information.

1   36.   An apparatus to create a digital model of a patient's teeth, comprising:
2   a radiation source;
3   a scintillator to receive the radiation from the radiation source;
4   a radiation detector coupled to the scintilllator;
5   a rotatable table positioned between the radiation source and the scintillator,
6   the table being adapted to support an impression of the patient's teeth; and
7   a computer coupled to the detector to generate the digital model with scanned
8   data.

1   37.   The apparatus of claim 36, wherein the radiation source is an X-ray
2   source.

1   38.   The apparatus of claim 36, wherein the radiation source is a computed
2   tomography source.

1   39.   The apparatus of claim 36, wherein the rotatable table is adapted to
2   support an upper teeth impression, a lower teeth impression and a bite impression.

1   40.   The apparatus of claim 36, further comprising a fabrication machine
2   coupled to the computer to generate a plurality of appliances, wherein the appliances

3   comprise polymeric shells having cavities and wherein the cavities of successive shells have

4   different geometries shaped to receive and resiliently reposition the teeth from one

5   arrangement to a successive arrangement.